

#### CLAIMS

1. A rubber composition which is a silica compounded rubber composition for tire comprising 100 parts by weight of a rubber component made of (a) from 20 to 80 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof and (b) from 80 to 20 % by weight of a diene-based rubber other than (a); and (c) from 40 to 100 parts by weight of a rubber reinforcing agent containing 40 % or more of silica, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-molecular substance.

2. A rubber composition which is a rubber composition for sidewall comprising 100 parts by weight of a rubber component made of (a) from 20 to 80 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof and (b) from 80 to 20 % by weight of a diene-based rubber other than (a); and (c) from 25 to 60 parts by weight of a rubber reinforcing agent, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-molecular substance.

3. A rubber composition which is a rubber composition for passenger automobile tire comprising 100 parts by weight of a rubber component made of (a) from 10 to 50 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one

unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof, (e) from 30 to 70 % by weight of a styrene-butadiene rubber, and (b) from 0 to 60 % by weight of a diene-based rubber other than (a) and (e); and (d) from 40 to 100 parts by weight of a rubber reinforcing agent, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-molecular substance.

4. A rubber composition which is a rubber composition for large-sized vehicle tire comprising 100 parts by weight of a rubber component made of (a) from 10 to 60 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof and (b) from 90 to 40 % by weight of a diene-based rubber other than (a); and (c) from 45 to 70 parts by weight of a rubber reinforcing agent, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-molecular substance.

5. A rubber composition which is a high-hardness compounded rubber composition comprising 100 parts by weight of a rubber component made of (a) from 20 to 80 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof and (b) from 80 to 20 % by weight of a diene-based rubber other than (a); and (c) from 60 to 100 parts by weight of a

rubber reinforcing agent, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-molecular substance.

6. A rubber composition which is a rubber composition for base tread comprising 100 parts by weight of a rubber component made of (a) from 20 to 80 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof and (b) from 80 to 20 % by weight of a diene-based rubber other than (a); and (c) from 22 to 55 parts by weight of a rubber reinforcing agent, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-molecular substance.

7. A rubber composition which is a rubber composition for tire cord coating comprising 100 parts by weight of a rubber component made of (a) from 10 to 60 % by weight of a vinyl-cis-polybutadiene rubber containing 1,2-polybutadiene having a melting point of 170 °C or higher and a high-molecular substance having at least one unsaturated double bond per a repeating unit and comprising at least one member selected from polyisoprene, crystalline polybutadiene having a melting point of not higher than 150 °C, liquid polybutadiene and derivatives thereof and (b) from 90 to 40 % by weight of a diene-based rubber other than (a); and (c) from 30 to 80 parts by weight of a rubber reinforcing agent, which is characterized in that the 1,2-polybutadiene is dispersed in a short crystalline fiber state and the high-molecular substance is dispersed in a granular state in the cis-polybutadiene rubber which is a matrix component of said vinyl-cis-polybutadiene rubber (a); and that the short crystalline fiber of the 1,2-polybutadiene is dispersed in particles of the high-

molecular substance.

8. The rubber composition according to ~~any one of claims 1 to 7~~, claim 1, which is characterized in that said vinyl-cis-polybutadiene rubber (a) is produced by a process for producing a vinyl-cis-polybutadiene rubber by subjecting 1,3-butadiene to cis-1,4-polymerization in a hydrocarbon-based solvent by using a cis-1,4-polymerization catalyst, subsequently making a 1,2-polymerization catalyst copresent in the resulting polymerization reaction mixture to subject the 1,3-butadiene to 1,2-polymerization, thereby forming 1,2-polybutadiene having a melting point of 170 °C or higher, and then separating, recovering and obtaining a vinyl-cis-polybutadiene rubber as formed from the resulting polymerization reaction mixture, which is characterizing by including a step for adding a high-molecular substance having at least one unsaturated double bond per a repeating unit within the production system of the vinyl-cis-polybutadiene rubber.

9. The rubber composition according to ~~any one of claims 1 to 8~~, claim 1, which is characterized in that in the production step of the vinyl-cis-polybutadiene rubber (a), the unsaturated high-molecular substance is contained in the range of from 0.01 to 50 % by mass based on the total sum of the crystalline fiber of 1,2-polybutadiene and the cis-polybutadiene rubber.

10. The rubber composition according to ~~any one of claims 1 to 9~~, claim 1, which is characterized in that the short fiber of 1,2-polybutadiene in said vinyl-cis-polybutadiene rubber (a) is also dispersed in the cis-polybutadiene rubber as the matrix component without being contained in the particles of the high-molecular substance; that the major axis length of the short crystalline fiber dispersed in said matrix is in the range of from 0.2 to 1,000  $\mu\text{m}$ ; and that the major axis length of the short crystalline fiber of the 1,2-polybutadiene dispersed in the particles of said high-molecular substance is in the range of from 0.01 to 0.5  $\mu\text{m}$ .

11. The rubber composition according to ~~any one of claims 1 to 10~~, claim 1, which is characterized that said vinyl-cis-polybutadiene rubber (a) has the following characteristics:

(1) the cis-polybutadiene rubber which is the matrix component of said vinyl-cis-polybutadiene rubber has a Mooney viscosity in the range of from 10 to 50;

(2) the cis-polybutadiene rubber which is the matrix component of said vinyl-cis-polybutadiene rubber has a viscosity in a toluene solution at 25 °C in the range of

from 10 to 150;

(3) the cis-polybutadiene rubber which is the matrix component of said vinyl-cis-polybutadiene rubber has an  $[\eta]$  in the range of from 1.0 to 5.0;

(4) the cis-polybutadiene rubber which is the matrix component of said vinyl-cis-polybutadiene rubber has a 1,4-cis-structure content in the range of 80 % or more;

(5) the 1,2-polybutadiene and the high-molecular substance are dispersed in a physically and/or chemically adsorbed state in the cis-polybutadiene rubber which is the matrix component of said vinyl-cis-polybutadiene rubber; and

(6) the high-molecular substance in said vinyl-cis-polybutadiene rubber is a boiling n-hexane insoluble matter.

12. The rubber composition according to claim 1, which is characterized that the diene-based rubber (b) other than (a) is a natural rubber and/or polyisoprene and/or a styrene-butadiene rubber.

13. The rubber composition according to ~~any one of claims 2 to 7,~~ claim 2, which is characterized that the diene-based rubber (b) other than (a) is a natural rubber and/or polyisoprene.

14. The rubber composition according to ~~any one of (claims 2 to 7,~~ claim 2, which is characterized that the rubber reinforcing agent is carbon black.